

U.S.S.N. 10,723,509

Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification has been amended to correct grammatical errors including amendments to overcome Examiners Drawings Objections.

The claims have been amended to clarify Applicants disclosed and claimed invention.

Support for the amendments is found in the original claims and the Specification.

No new matter has been added.

For example support for limitations in new claims 44, 45, 46 and 51 are found in the Specification at:

Paragraph 0013:

"Although the present invention is explained by reference to an exemplary dual damascene formation process, it will be that the method of the

U.S.S.N. 10,723,509

present invention applies generally to the formation of damascenes including single vias and trench lines extending through single or multiple TMD layers.

While the method is particularly advantageous for forming copper damascenes in porous low-K dielectrics, it will be appreciated that the method may be applied to the formation of other metal damascenes and other dielectric insulating layers, particularly where damascene opening aspect ratios are greater than about 4, where the method of the present invention will advantageously improve step coverage of seed layers to improve a copper ECP process."

and at paragraph 0025:

"Advantageously, the plasma treatment serves to reduce (remove) any oxides formed on the seed layer, preferably forming a substantially oxide-free seed layer surface. By the term "substantially oxide-free" is meant that greater than about 90% of the seed layer surface is essentially free of oxides."

Claim Rejections under 35 USC 102(b)

Claims 1-29 stand rejected under 35 USC Section 102(b) as being clearly anticipated by Lin et al. (US 6,342,448).

Lin et al. disclose a method for forming an improved TaN

U.S.S.N. 10,723,509

barrier layer. Lin et al. disclose forming a first Ta layer followed by a middle TaN layer followed by an upper Ta layer (see Abstract). Lin et al. teach that the upper Ta layer (18 to 22 Angstroms thick) improves wetting of an overlying copper seed layer (see e.g., col 9, lines 8-25).

Thus, Lin et al. do not disclose several aspects of Applicants disclosed and claimed invention.

Nowhere do Lin et al. disclose or suggest plasma treating a seed layer.

Nowhere do Lin et al. disclose forming a first and second seed layer on a diffusion barrier layer.

Apparently, Examiner is mistakenly interpreting Lin et al.'s **Ti/TaN/Ti composite barrier layer** (col 9, lines 10-12) as being rearrangeable to be equivalent to Applicants disclosed and claimed first and second **seed layer**, nowhere disclosed or suggested as such by Lin et al. Lin et al. disclose and teach a **single copper seed layer on the composite barrier layer** (with the copper seed layer being 1200 to 2500 Angstroms thick) (col 9,

U.S.S.N. 10,723,509

lines 13-20).

In any event, nowhere do Lin et al. disclose or suggest:

"Forming a diffusion barrier layer to line the damascene opening;

then forming a first seed layer on the diffusion barrier;

then plasma treating the first seed layer in-situ with a first treatment plasma **formed from** plasma source gases selected from the group consisting of argon, nitrogen, hydrogen, and NH₃;

then forming a second seed layer on the first seed layer;"

Lin et al., is clearly insufficient to anticipate Applicants disclosed and claimed invention.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051,

U.S.S.N. 10,723,509

1053 (Fed. Cir. 1987).

"The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

With respect to claims 2 and 3, nowhere do Lin et al. disclose or teach two seed layers or that at least one of the first and second layers are formed having continuous layer over active areas of the substrate.

With respect to claims 4 and 5, nowhere do Lin et al. disclose or teach two seed layers or that one of the first and second seed layers are conformally or nonconformally deposited.

With respect to claims 12 and 24, and 17 and 29 the disclosure of two species in a Markush claim does not anticipate the claim. It is also not clear which layers of Lin et al. the Examiner is mistakenly interpreting to be barrier layers and which are mistakenly interpreted to be seed layers.

With respect to claims 15 and 27, the disclosure that the

U.S.S.N. 10,723,509

TaN portion of the composite barrier layer is from 230 to 285 Angstroms in no way anticipates a first seed layer from 50 to 300 angstroms thick. In this version of Examiners mistaken interpretation of Lin et al., the composite barrier layers of Lin et al. are apparently interpreted to be seed layers i.e., equivalent to at least 3 seed layers in Lin et al. (TaN/Ta/Cu) and it is not clear which layer the Examiner would interpret the barrier layer to be (Ta?) contrary to the teachings of Lin et al., since Lin et al. **disclose a Ta/TaN/Ta composite barrier layer and a single copper seed layer.**

Nevertheless, Lin et al. do not disclose, suggest, or teach Applicants plasma treatment step.

Since Lin et al. fail to anticipate Applicants disclosed and claimed invention with respect to Applicants independent claims, neither do Lin et al. anticipate Applicants dependent claims.

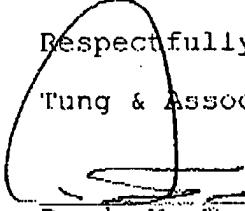
Based on the foregoing, Applicants respectfully submit that all of the Claims including the newly added claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

U.S.S.N. 10,723,509

In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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